

REMARKS

This Amendment and Reply seeks to place this application in condition for allowance. Several of the claims have been amended to correct inadvertent typographical errors and to improve grammar and/or clarity. No new matter has been added.

In the Office Action of April 19, 2004 (hereinafter the "Office Action"), several of the claims have been found to contain patentable subject matter. In addition, several of the claims were rejected. All of the rejections raised in the Office Action have been addressed herein. Each of the objections and rejections are addressed below in detail and in the order presented in the Office Action.

Amendment to the Claims

Several of the claims have been amended to correct inadvertent typographical errors, to improve grammar and/or clarity, and to more definitely set forth the novel and unobvious features of Applicants' invention(s). No new matter has been added.

For example, claims 1, 17 and 34, as amended, recite a substrate having a wafer or wafer-like shape. The specification, on page 9, lines 9-16 and on page 12, pages 3-10 (among others), describes the substrate, in one embodiment, having a wafer or wafer-like shape:

In one embodiment, the EIW is a wafer or wafer-like object. When the EIW is a wafer-like object, the EIW may have a different physical form factor than a product wafer. The processing equipment, however, may handle such an EIW without adverse modification to its hardware and/or software. For example, where an EIW includes circuitry, sensors and/or sources to monitor a CVD process, the EIW may have the same or substantially the same planar size and shape as a product wafer, but may be (slightly) thicker. As such, the EIW "behaves" like a thick wafer and the deposition equipment may

handle the EIW with little or no modification to the equipment. ('563 app., page 9, lines 9-16).

The Sensor-EIW may also include circuitry and components that protrude from the surface, hence creating a portion that includes a non-flat surface topography. The circuitry and components are disposed on a wafer-like object that may be handled (automatically or manually) within the equipment. Thus, such an EIW includes a substrate that has a similar form factor and/or profile as a product wafer ('563 app., page 12, lines 3-10).

Notably, none of the amendments were motivated by patentability considerations in view of the prior art, including the art relied on in the outstanding Office Action.

Rejection of the Claims under 35 USC §§ 102 and 103

In the Office Action, many of the claims were rejected as being anticipated by, or obvious in view of, Avanzino et al. (U.S. Patent 6,562,185). Applicants respectfully disagree. For at least the reasons set forth below, none of the claims are anticipated by or obvious in view of Avanzino et al.

Avanzino et al.

Avanzino et al. describe a system for characterizing a chemical mechanical polishing process (i.e., a surface planarization technique in which high elevation features are selectively removed, via a polishing pad, resulting in a topology with improved planarity). (See, Col. 6, lines 3-11). Avanzino et al. employ a wafer, having one or more temperature sensors in or on the wafer to permit monitoring of the wafer's temperature when undergoing chemical mechanical polishing processing. (See, Col. 7, lines 27-32 and Figures 3, 4, 5, 6, 9 and 12). The wafer may also include "other temperature sensor related equipment (e.g., signal processing circuitry, power source, electrical temperature

transducer, etc) ... to facilitate reading temperature data from temperature sensors" (Col. 8, lines 35-42).

In addition to the wafer, the Avanzino et al. system also includes a temperature monitoring system, a CMP system and data storage. Briefly, the temperature monitoring system, which is distinct and separate from the wafer, takes temperature readings from the temperature sensors in or on the wafer. (See, Col. 5, lines 20-23, Col. 8, lines 64 to Col. 9, lines 26; and Figures 1 and 7). The temperature readings may be taken before, during and/or after the chemical mechanical polish of the wafer. (See, Col. 5, lines 19-21 and lines 23-28, and Col. 8, lines 64 to 67). Indeed, the temperature monitoring system may time its reading of the temperature sensors on the basis of one or more earlier temperature readings. (See, Col. 8, line 64 to Col. 9, line 26).

The CMP system of Avanzino et al. performs the chemical mechanical polish of the wafer. (See, Col. 5, lines 18-19, Col. 11, lines 5-23, and Figure 8). While performing the polishing process, the CMP system records information associated with pad, slurry, pressure and motion information. (See, Col. 6, lines 16-48). The CMP system may also correlate such information with the temperature readings provided to the CMP system by the temperature monitoring system. (See, Col. 8, lines 27-31).

Notably, the pad, slurry, pressure and motion information appears to be obtained from the CMP system. Such information does not appear to be provided by or from any sensor(s) disposed on or in the wafer. Indeed, temperature sensors appear to be the only sensors disposed in or on the wafer. (See, for example, the discussions and illustrations of the wafer at Col. 5, lines 1-2, 46-51, Col. 7, lines 27 to Col. 8, line 17; Col. 8, lines 19-48; Col. 11, lines 58-61; Col. 13, lines 43-57; and Figures 3, 4, 5, 6 and 12). This notwithstanding, there is no mention of how such information is monitored by and obtained

from the CMP system, presumably because the CMP system and process are well known. (See, for example, Col. 11, lines 5-37).

The Avanzino et al. system, in at least one embodiment, also describes a CMP control system "to analyze temperature information, other information (e.g., pad, pressure, wafer, slurry, motion) and relations between such information to control the CMP system". (Col. 9, lines 52-56; and Figure 7). In this regard, in the event a desired temperature is not achieved, the CMP control system "adjusts one or more CMP parameters (e.g., slurry dispense rate, pressure) to facilitate achieving such a desired temperature." (Col. 9, lines 58-63). Thus, the CMP control system, in at least one embodiment, adjusts the performance of the CMP system based on the temperature readings.

Claimed Independent Inventions

Independent claim 1, as amended, describes a sensor unit for sensing process parameters of a process to manufacture an integrated circuit using integrated circuit processing equipment. The sensor unit includes a first sensor to sample a first process parameter and a second sensor to sample a second process parameter, wherein the first sensor and the second sensor are different types of sensors. Further, the second process parameter is different from the first process parameter. Both the first sensor and the second sensor are disposed on or in the substrate, which includes a wafer or wafer-like shape.

Independent claim 17, as amended, describes a sensor unit for sensing a first process parameter of a process to manufacture an integrated circuit using integrated circuit processing equipment. The sensor unit of claim 17 includes a source to generate an interrogation signal and a first sensor to sample a first process parameter using the

interrogation signal. Both the source and the first sensor are disposed on or in the substrate (which includes a wafer or wafer-like shape).

Finally, independent claim 34, as amended, describes a sensor unit for sensing first and second process parameters of a process to manufacture an integrated circuit using integrated circuit processing equipment. The sensor unit includes first source to generate an interrogation signal, a first sensor array including a plurality of first sensors to sample a first process parameter using the interrogation signal, and a second sensor array including a plurality of second sensors to sample a second process parameter. Claim 34, as amended, recites that the first sensors are different types of sensors from the second sensors. Further, the first source, the first sensors and the second sensors are disposed on or in the substrate (which includes a wafer or wafer-like shape).

Avanzino et al. Neither Anticipates, nor Renders Obvious the Claimed Inventions

There are many inventions described in the instant application. In an effort to present a more concise response, the discussion below focuses on only selected aspects or features of the independent claims. These are not the only reasons the inventions of the independent claims are patentable over Avanzino et al.

Moreover, many of the dependent claims, as noted by in the Office Action, present patentable subject matter. Those dependent claims are not discussed in detail herein.

As such, Applicants' response to this rejection is not exhaustive by any means; however, for the sake of brevity, the remarks focus on only some of the patentable aspects or features of the independent claims.

Claim 1

Avanzino et al. do not teach or suggest, among other things, a sensor unit including first and second sensors to sample first and second process parameters, respectively, wherein (1) the first sensor and the second sensor are disposed on or in the substrate (which includes a wafer or wafer-like shape) and (2) the first sensor is a different type of sensor from the second sensor. In contrast, Avanzino et al. appear to disclose a wafer including only temperature sensors -- i.e., one type of sensor. As described above, any other adjustment of the CMP parameters is (1) performed by systems not disposed on or in the wafer, or (2) derived or estimated by a controller (or the CMP control system) from the temperature data obtained by the temperature monitoring system. (Col. 10, line 62 to Col. 11, line 4; See also, Col. 14, lines 38-48). For example, slurry variables are neither measured nor sampled via sensors on the wafer. Although the Avanzino et al. system may employ the temperature data to update one or more CMP parameters (Col. 10, lines 62 to Col. 11, line 3), that does not change a sensor that samples temperature into a sensor that samples pressure and/or motion.

Moreover, the Avanzino et al. system would not motivate one skilled in the art to include sensors to sample additional parameters since the Avanzino et al. system appears to employ the temperature data to determine whether "to update one or more CMP parameters (e.g., pressure, speed, slurry properties)" (Col. 10, line 62 to Col. 11, line 4; See also, Col. 14, lines 38-48 and Figures 10, 11 and 13). Thus, the Avanzino et al. system does not contemplate an additional type or types of sensors being disposed on or in the wafer to sample a process parameter that is different from temperature.

Claim 17

Avanzino et al. do not teach or suggest, among other things, a sensor unit including a source (disposed on or in the substrate which has a wafer or wafer-like shape) to generate an interrogation signal and a first sensor (disposed on or in the substrate) to sample a first process parameter using the interrogation signal. In short, the Avanzino et al. wafer does not describe, among other things, a source disposed on or in the wafer. The temperature sensors on or in the wafer of Avanzino et al. appear to employ no signal whatsoever to sample the temperature. Rather, the temperature sensors appear to continually measure the surrounding temperature.

It is the temperature monitoring system -- which is neither disposed on nor in the wafer -- that acquires the temperature sampled by the temperature sensors. (See, Col. 5, lines 20-23 and lines 33-34, Col. 8, lines 64 to Col. 9, lines 26; and Figures 1 and 7). The temperature monitoring system may take temperature readings: (1) before, during and/or after the chemical mechanical polish of the wafer, and (2) on the basis of one or more earlier temperature readings. (See, Col. 5, lines 19-21 and lines 23-28, and Col. 8, line 64 to Col. 9, line 26). Regardless of how or when such temperature readings are taken by the temperature sensing unit, the temperature sensors apparently neither use nor receive a signal to measure the temperature (let alone: (i) an interrogation signal and (ii) an interrogation signal from a source disposed on or in the wafer).

Moreover, the Avanzino et al. system would not motivate one skilled in the art to include temperature sensors to sample the temperature using an interrogation signal. When temperature readings are taken, is determined by the temperature monitoring unit (embodiment of Figures 1 and 7). The temperature sensors neither use nor receive a signal to measure the temperature. That is, Avanzino et al. makes no mention that the

temperature sensors sample the temperature of the surrounding area in response to a signal from the temperature monitoring unit. (Compare, Col. 7, line 62 to Col. 8, line 17).

Claim 34

Avanzino et al. neither teach nor suggest, among other things, a sensor unit having (1) first and second sensors to sample first and second process parameters, respectively, (2) first sensors that are different types of sensors from the second sensors, and (3) a source (disposed on or in the substrate which has a wafer or wafer-like shape) to generate an interrogation signal and the first sensor (disposed on or in the substrate) to sample the first process parameter using the interrogation signal. As described above with respect to amended claim 1, Avanzino et al. appear to disclose a wafer including only one type of sensor, namely temperature sensors. Notably, although the Avanzino et al. system may employ the temperature data to update one or more CMP parameters (Col. 10, lines 62 to Col. 11, line 3), that does not change a sensor that samples temperature into a sensor that samples pressure and/or motion.

Further, as described with respect to amended claim 17, the Avanzino et al. wafer does not teach or suggest a source disposed on or in the wafer nor a sensor that samples a process parameter using the interrogation signal from the source. The temperature sensors on or in the wafer of Avanzino et al. appear to employ no interrogation signal to sample the temperature. The temperature monitoring system -- which is neither disposed on nor in the wafer -- interrogates the temperature sensors to acquire the temperature sensed by the temperature sensors.

Moreover, the Avanzino et al. system would not motivate one skilled in the art to include different types of sensors to sample different parameters since the Avanzino et al. system appears to employ a controller to analyze the temperature data "to update one or

more CMP parameters (e.g., pressure, speed, slurry properties)". (Col. 10, line 62 to Col. 11, line 4; See also, Col. 14, lines 38-48 and Figures 10, 11 and 13).

Avanzino et al. would not motivate one skilled in the art to include sensors to sample the temperature using an interrogation signal. When temperature readings are taken, appears to be determined by the temperature monitoring system. The temperature sensors of Avanzino et al. sample the temperature of the wafer without using any signal from the temperature monitoring system. (See, Col. 7, line 62 to Col. 8, line 17).

Dependent Claims

Many of the dependent claims have been found to include patentable subject matter. Applicants provide no additional comments pertaining thereto.

As for the rejected dependent claims, for the sake of brevity, the additional reasons those dependent claims are patentable over Avanzino et al. are not set forth herein. However, for at least the reasons stated above, it is respectfully submitted that such rejected dependent claims are patentable in view of Avanzino et al.

Prior Art Made of Record

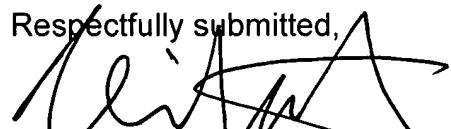
Applicants note the prior art made of record but not relied upon. It is not clear what is meant by the comment that the prior art made of record "is considered pertinent to applicants' disclosure." (See, Office Action, page 5). No inference or conclusion should be drawn that Applicants agree, in any way, with the Examiner's characterization of such prior art. In an effort to provide a more concise response, and because the Examiner has not rejected any of the claims based on the prior art made of record (but not relied upon), Applicants do not provide comments on the Examiner's characterization.

CONCLUSION

Applicants respectfully request entry of the foregoing amendment and reconsideration of the instant application. Applicants submit that the pending claims present patentable subject matter. Accordingly, allowance of all of the claims is respectfully requested.

It is noted that should a telephone interview expedite the prosecution of this application in any way, the Examiner is invited to contact the undersigned at the telephone number listed below.

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Respectfully submitted,


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